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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for March, 1887, and is based upon reports of regular and voluntary observers of both countries.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of two hundred and thirty-eight vessels have been used. The general character of the weather over the north Atlantic Ocean was particularly severe during the second, and early portion of the third, decade of the month.

The southward movement of Arctic ice was unusually large for the season, and heavy ice jammed in on the coast of Newfoundland, in the vicinity of Saint John's, at intervals from the 11th to 23d.

On chart i for this month are traced the paths of eleven areas of low pressure; this is one less than the average number for March during the past thirteen years. No storm of unusual severity occurred, although low area number ix exhibited considerable energy during its presence in the Lake region and Ohio Valley on the 24th, it being attended by high winds, heavy rain or snow, and in Ohio by thunder-storms.

The mean pressure of the month was very nearly normal in all parts of the country; in Maine and the Canadian Maritime Provinces it was slightly below, and in the upper lake region and Mississippi valley slightly above, the normal.

The temperature has been below the normal in all states bordering on the Lakes and Atlantic Ocean, along the east

Gulf coast, and in southern Texas; in all other districts the month has been warmer than the average March. The extremely low temperatures that prevailed in the Southern States on the 18-19th and 29-30th were accompanied by frosts which were destructive to vegetables and blossoms of fruit trees.

The precipitation was generally below the normal in all parts of the country, except Washington Territory, Oregon, Idaho, and extreme southern Texas; at the end of the month the remainder of the state was still suffering from the long drought.

In the preparation of this REVIEW the following data, received up to April 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-three Canadian stations, as telegraphed to this office; one hundred and fifty-seven monthly journals; one hundred and fifty-eight monthly means from Signal Service stations; twenty-three monthly means from Canadian stations; two hundred and eighty monthly registers from voluntary observers; fifty-eight monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Arkansas, Illinois, Indiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, Ohio, Oregon, South Carolina, and Tennessee; and of the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for March, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

On this chart are shown two areas of high pressure, the first extends over Minnesota, Dakota, and northward beyond the limit of observation, and is enclosed by the isobar of 30.15; at two stations within this line, Saint Vincent, Minn., and Fort Garry, Manitoba, the highest mean pressure of the month, 30.18, is attained. From this region eastward the pressure decreases rapidly until in New England the isobar of 29.80, and in Nova Scotia 29.75, is reached; within the latter line the lowest mean pressure of the month, 29.71, at Sydney, Cape Breton Island, occurs. The second area of high pressure, also bounded by the isobar of 30.15, is situated in Oregon and northern California, from this region northeastward to central Montana and southeastward to Arizona the pressure decreases, attaining a mean of 29.98 at Fort Maginnis, Mont., and 29.97 at Yuma, Ariz. The position of the areas of highest and lowest pressure for the present month and for March, 1886, nearly coincide.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure.

The mean pressure of the month is normal, or nearly so, in all parts of the country, except Maine and the Canadian Maritime Provinces, where departures below the normal, ranging from .06 at Portland, Me., to .19 at Sydney, Cape Breton Island, occur. In New England, the middle Atlantic states, south Atlantic states, Florida, and the east Gulf states, the pressure of the month is from .01 to .08 below the normal pressure for March. From the districts named westward to the Pacific Ocean the pressure is slightly above the normal, the largest departures occurring in the upper lake region and upper Mississippi valley, where they range from .06 at several stations to .11 at Escanaba, Mich., and .13 at La Crosse, Wis., in excess of the normal; in Nevada and northern California it is about .07.

When compared with the pressure of the preceding month, February, 1887, very large differences, both above and below, occur. Along the Pacific coast and in the Rocky Mountain regions the pressure for March is from .03 to .18 in excess of that of February; in Washington Territory, Oregon, and northern California the excess averages about .13. From the Rocky Mountain region eastward to the Atlantic Ocean the pressure is below that of the preceding month, the deficiencies becoming very large in the eastern part of the country, averaging along the Atlantic about .25.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. The largest ranges occur in New England, the lower lake region, and middle Atlantic states; the smallest in California. The following are some of the extreme ranges:

Greatest.		Least.	
	Inch.		Inch.
Eastport, Me	1.98	San Diego, Cal.....	0.28
Portland, Me	1.86	Los Angeles, Cal.....	0.28
Block Island, B. I.	1.80	Yuma, Ariz.....	0.37
Boston, Mass	1.79	San Francisco, Cal.....	0.41
New London, Conn	1.78	Sacramento, Cal.....	0.44
New Haven, Conn.....	1.73	Red Bluff, Cal.....	0.46
Mount Washington, N. H.....	1.60	Fort Grant, Ariz.....	0.50

AREAS OF HIGH PRESSURE.

In the examination of the tri-daily weather charts of the United States and the Dominion of Canada, eight well-defined areas of high pressure have been traced with sufficient accuracy to warrant a brief description of each as to its movements and its relation to other current phenomena. The general direction of movement of these areas was easterly, with two exceptions, numbers v and viii, which were a little east of south. They first appeared in the field of observation at the stations located in British America, just north of Montana and Washington Territories, with the exceptions of numbers iii and iv, which were first noticed upon the Pacific coast of the United States.

The intimate relation prevailing between areas of low temperature, cold waves, and areas of high pressure makes it convenient to discuss their movements and conditions in the same text, although it is not proper to say that a cold wave, as defined by the rules of the Signal Service, is always found with an area of high pressure. It will be well to state here that the definition of a "cold wave" is that there must be a sudden and decided fall of fifteen or more degrees in temperature, after eliminating the diurnal changes, and that this fall must be to, or below, the point at which frost is formed.

The following are general descriptions of the several areas of high pressure traced:

I.—The afternoon reports of the 1st indicated the presence of an area of high pressure to the northward of Washington Territory, the isobar of 30.30 extending southward into western Oregon. Subsequent reports located its path eastward into British Columbia thence over Manitoba, bending to the southeast over Lake Superior, and passing directly eastward over Upper Canada into the Gulf of Saint Lawrence on the 6th. The uniformity of pressure above the normal, from .4 to 1.00, which this area maintained, was remarkable. Its centre did not come within the range of stations making telegraphic reports until the morning of the 3d, when it was just north of Dakota, with a corrected reading of 30.99. When it passed into the Gulf of Saint Lawrence on the 6th it had only fallen to 30.84. During its passage eastward cold northerly winds prevailed in all the regions south of its track, except along the northern coast of the Gulf of Mexico. The temperature fell to the freezing point as far south as the thirty-sixth parallel. The lowest temperatures accompanying this cold wave were -34° in Manitoba on the 4th, and -33° in Lower Canada on the 5th. It also fell below zero in Dakota, Minnesota, northern Michigan, and northern New England.

II.—This area appeared in the Saskatchewan Valley on the evening of the 6th, with a pressure of 30.37 and a temperature of -9° . It moved over a path almost directly east-southeast and arrived on the New England coast on the morning of the 9th, with an isobar of 30.40. During its progress eastward the temperature fell below the freezing point in the upper Mississippi valley, the Lake region, and New England. It being closely followed by an area of low pressure, the lowest temperature did not continue at any point over twenty-four hours.

III.—The evening reports from the Oregon coast of the 4th indicated the presence of an area of high pressure in the Pacific

Ocean just off the coast. The pressure at Roseburg, Oregon, was 30.21. From this time until the morning of the 8th this area remained nearly stationary, its centre appearing to oscillate over a region of about two hundred miles in diameter, including the southern Oregon and north California coasts. As is usually the case when an area of high pressure is located in this vicinity, southerly winds and rain prevailed in Oregon and Washington Territory, and continued for ninety-six hours, or until the area moved eastward. On the afternoon of the 8th the reports indicated that the high area had started eastward, the highest pressure, 30.48, being in northern Utah. It then pursued a course southwestward into Colorado, then eastward into central Kansas, then northeastward, arriving over the region just north of Lake Superior on the morning of the 10th. It slowly drifted southeastward over the Lake region and middle Atlantic states and disappeared after the evening observation of the 12th. The pressure gradient surrounding this high area was uniformly light, and seldom exceeded one tenth of an inch to one hundred miles. The decrease in the temperature with this area was moderate throughout its path, being most decided in the lower lake region, where 20° above zero was recorded on the morning of the 12th.

IV.—This area was first observed over the country just north of Montana on the morning of the 12th, with a pressure of 30.66. It moved to northern Minnesota by the afternoon of the 13th, registering a pressure of 30.80. Its course after this date was in a northeasterly direction toward Hudson Bay. During its progress the gradient was often quite steep, sometimes indicating a change of pressure of one-tenth of an inch to thirty-three miles. During the time the isobars were most crowded brisk and high winds prevailed over Dakota, Minnesota, and Wisconsin. Freezing temperature was experienced southward to Kansas, Missouri, and Kentucky, and a minimum depression to zero was recorded in northern Dakota and Minnesota. The southern limit of this area extended to the Gulf of Mexico.

V.—The evening reports of the 18th indicated the approach of an area of high pressure into Montana from the northwest, the station at Calgary, Northwest Territory, reporting a reading of 30.19. It had moved southeastward into Montana by the morning of the 20th, with highest pressure 30.50. After this its path was almost due south, leaving the coast of Texas on the evening of the 22d. The pressure gradually decreased as it moved southward, and when last observed in Texas as defined area, 30.25 was the maximum pressure. The temperature accompanying this area was below the freezing point until it arrived in southern Texas. The pressure gradient was light, and the wind velocities were moderate. The unusual southerly course of this high area appears to have been influenced by the presence of an area of low pressure in the western portion of the Gulf of Mexico, having an easterly course.

VI.—This area first appeared in the country north of Dakota on the morning of the 24th, with an isobar of 30.10 and a temperature slightly below zero. By the morning of the 26th the central portion had reached northern Minnesota, with a pressure of 30.50. After this date its progress was towards the southern part of Hudson Bay, then directly southeastward to Nova Scotia. It passed into the Atlantic Ocean on the evening of the 27th, with a pressure of 30.30. During its progress eastward cold northerly winds prevailed directly south of its path, with some precipitation in the lower lake region. So far as could be determined by the observations received, the gradient was uniformly light.

VII.—The reports received on the evening of the 26th indicated the presence of a high area over British Columbia. On the evening of the 27th the pressure permitted an isobar of 30.70 to be drawn in western Manitoba, with a gradient to the south of about one-tenth of an inch to fifty miles. Subsequent observations defined its path to be slightly north of east. Arriving at a point north of Minnesota on the afternoon of the 28th there were indications of the area dividing, for the isobar of 30.30 extended southward into Missouri, while the distance

between its east and west line was less than five hundred miles. The separation had been completed on the afternoon map, as a distinct area covered the lower Missouri and Mississippi valleys, with a maximum pressure of 30.36 in Missouri. This second high area moved slowly eastward, covering the entire region east of the Mississippi River, and was central over the New England States on the evening of the 31st, with an isobar of 30.30. The conditions prevailing along its easterly path was generally dry, pleasant weather and light winds.

VIII.—The reports from Montana on the afternoon of the 30th permitted the drawing of an isobar of 30.40 in the northern portion. About the same time an area of low pressure was moving eastward over the lower Mississippi valley. The area of high pressure moved rapidly southward and occupied western Texas on the evening of the 31st, with a pressure diminished to 30.28. During its progress southward its gradient was light and the temperature slightly below freezing, except in southern Texas.

AREAS OF LOW PRESSURE.

Eleven areas of low pressure have been defined and their paths traced from the tri-daily telegraphic observations received from the stations controlled by the Canadian Meteorological Office and the United States Signal Service during the month of March. In investigating the many barometric depressions appearing on the tri-daily March maps it was decided to discuss and trace only those areas which displayed decided cyclonic conditions, such as the general inflow of the surrounding air, the apparent movement of the area, and the final appearance of cloud and precipitation. The unavoidable absence of reports from the Pacific coast stations during the last two-thirds of the month prevented the use of the reports from that region in tracing low areas passing over the Pacific coast states. Of the eleven paths defined, seven were first noticed in the country north of Montana and Dakota, two in Colorado, one in northern Texas, and one in southern Dakota. The direction of the paths of the low areas was generally easterly, but a reference to chart i will show an unusual and remarkable diversity of courses pursued. It will be noticed, however, that upon approaching the Atlantic coast the paths have a tendency toward the forty-fifth parallel, off the Gulf of Saint Lawrence. The westerly and then northerly movement of number ii will be noticed as extraordinary, and will be more fully discussed under the proper headings.

The following table will show the latitude and longitude in which the apparent centre of each low area was first and last observed, and average hourly progress it made in travelling the routes described on chart i:

Areas of low pressure.	First observed.			Last observed.			Average progress in miles per hour.
	Date and time.	Lat. N.	Long. W.	Date and time.	Lat. N.	Long. W.	
No. I.....	1, 7 a. m.	51 00	100 00	2, 10 p. m.	49 00	60 00	43.0
II.....	2, 3 p. m.	41 00	106 00	7, 10 p. m.	60 00	69 00	16.0
III.....	6, 3 p. m.	36 00	100 00	7, 10 p. m.	38 00	75 00	43.0
IV.....	6, 10 p. m.	51 00	119 00	11, 3 p. m.	44 00	62 00	34.0
V.....	9, 3 p. m.	54 00	114 00	14, 7 a. m.	37 00	70 00	19.0
VI.....	17, 3 p. m.	49 00	115 00	23, 11 p. m.	49 00	57 00	30.0
VII.....	19, 7 a. m.	44 00	99 00	21, 3 p. m.	34 00	78 00	22.0
VIII.....	22, 2 p. m.	53 00	105 00	23, 3 p. m.	49 00	83 00	34.0
IX.....	23, 7 a. m.	51 00	114 00	25, 10 p. m.	47 00	59 00	42.0
X.....	24, 3 p. m.	41 00	107 00	29, 3 p. m.	47 00	58 00	23.0
XI.....	28, 3 p. m.	50 00	113 00	30, 3 p. m.	34 00	74 00	32.0

Average rate of progress, 31 miles per hour.

Referring to chart i, it will be noticed that the apparent centres of the eleven areas of low pressure in moving eastward crossed either southern Manitoba, southern Dakota, or northern Texas on the one hundredth meridian.

The following are brief descriptions of the areas of low pressure traced, with mention of some of the more important meteorological conditions attending them:

I.—The morning reports of the 1st located this area in Manitoba, having a minimum pressure of 29.45, with light winds and some cloudiness. An area of high pressure was central over the northern portion of the Gulf of Mexico, with an isobar

of 30.40. The gradient between the two areas was nearly uniform, averaging about one hundred miles to the tenth of an inch. The path pursued by this area was a little south of east, arriving in the Province of Ontario on the morning of the 2d. It then followed the Saint Lawrence Valley and passed off the coast on the evening of the 2d, with lowest pressure 29.58. No precipitation occurred along its path until it reached the Maritime Provinces, where light snow fell on the 2d. The centre of the area was closely followed by colder northerly winds, becoming fresh and brisk over the Lake region.

II.—The isobar of 29.90 was constructed wholly within the limits of Colorado on the evening of the 2d, while a high area was to the northward in the Saskatchewan Valley, with a pressure of 30.68. During the next forty-eight hours the progress of this area was not more than four hundred miles, and the centre continued within the limits of Colorado, with a gradual decrease in pressure to 29.64. A reference to chart i will show its peculiar path southward, then westward, and finally northward on the evening of the 4th, being apparently attracted toward the British American border by a depression in that vicinity. The evening reports of the 4th indicated that the two depressions had merged into one, and was central just north of Montana, with a pressure of 29.41. At this time a high area was located north of Lake Huron, with a maximum pressure of 30.88. Between the two areas there was a difference of pressure of 1.47, and of temperature, 40°. Severe gales prevailed in Minnesota and Manitoba during the succeeding night. The low area at once started eastward, passing over Manitoba, then southeastward to the New England coast, the central pressure having increased to 30.06. During its progress eastward both the pressure and temperature gradients decreased, and no dangerous winds were reported after leaving Manitoba. Rain or snow prevailed over the entire region east of the Mississippi River.

III.—During the time that number ii was in Manitoba a slight depression was noticed forming in southern Texas. The afternoon reports of the 6th showed an isobar of 29.80 in that region. A high area was located off the coast of South Carolina, with a maximum pressure of about 30.25. The barometer gradient between the two areas was about two hundred and twenty miles for each tenth of an inch pressure. There was no perceptible temperature gradient. Number iii at once started eastward and passed off the Virginia coast on the evening of the 7th. Its course was slightly north of east, and its rate of progress forty-three miles per hour. Heavy rain, with occasional thunder, prevailed in all the states south of Kansas, Missouri, and the Ohio River. The low pressure and temperature gradients continued throughout its course.

IV.—This area of low pressure appeared to be located north of Washington Territory on the evening of the 6th, and extended southeastward, in a trough like shape, to northern Wyoming. By the evening of the 7th it had moved southeastward into western Montana, with the isobar of 29.80 extending into northern Wyoming. It moved rapidly eastward into southeastern Dakota, and then turned southward and reached northern Texas on the afternoon of the 8th. At this point it was bounded by an isobar of 29.80, but the isobar of 29.90 extended from southern Texas to northern Minnesota, indicating a subsidiary low area in Minnesota. It moved eastward from Texas into northern Arkansas, and then directly northeast to Michigan. The subsidiary low joined it at this point. Although the lowest pressure was over Michigan within an isobar of 29.90, yet the isobar for 30.00 extended to the Gulf of Mexico and preserved the trough like condition previously noted. The path pursued by this low area after leaving Michigan was eastward to the vicinity of Montreal, then southward to the coast of New Jersey, joining a low area which had formed over the Chesapeake Bay on the evening of the 9th. It at once changed its course and moved northeastward, disappearing off the coast of Nova Scotia on the evening of the 11th. During its eastward progress after leaving Michigan general rains commenced over the lower lake region and the country east of the

Appalachian range. Brisk and high northerly winds prevailed along its path off the Atlantic coast.

V.—The pressure of 29.75 reported from Calgary, Northwest Territory, on the afternoon of the 9th indicated a fall of .17 in the past eight hours. During the next forty-eight hours a well defined area of low pressure had moved southeastward to the country just north of Montana, with a minimum pressure of 29.34. During this time dry and warm southerly winds had commenced to prevail over the Rocky Mountain region and Missouri Valley. A high pressure area was located north of Lake Huron, with a maximum reading of 30.42. The low area first moved rapidly to southern Minnesota, then changing its course to northeastward it appeared over Lake Superior on the evening of the 12th. The central isobar had risen to 29.80, but as a high area had moved from the north into northern Dakota, with a maximum reading of 30.77, the gradient to the westward was quite steep and severe gales prevailed in Dakota and Minnesota. The course travelled by the low area from Lake Superior was directly toward the North Carolina coast, followed by light snow in the Lake region and rain in the middle Atlantic states, and freezing weather throughout the country north of the thirty-fifth parallel. Dangerous winds prevailed in the upper lake region.

The following notes from observers relate to this storm:

Fort Totten, Dak.: high southerly winds prevailed during the afternoon of the 11th. On the 12th the barometer rose rapidly and a violent gale blew from the northwest, maximum velocity sixty-four miles per hour. The observer at Moorhead, Minn., reports light rain with brisk southerly winds on the 11th; on the 12th the wind veered from south to northwest and a gale set in at 11.40 a. m., continuing until 4.50 a. m. of the 13th, maximum velocity, thirty-six miles per hour, at 3 p. m. of the 12th.

Marquette, Mich.: at 1.15 a. m. of the 13th a heavy gale set in from the northwest and continued until 11.46 p. m., blowing at an average rate of twenty-eight miles per hour and reaching a maximum of thirty-nine miles per hour at 5.19 a. m. The gale did considerable damage by blowing down chimneys, telegraph wires, etc. Snow fell during the night of the 13-14th and until 12.30 p. m. of the 14th.

Milwaukee, Wis.: on the 13th a northwesterly gale prevailed from 3.30 a. m. until 2.50 p. m., attaining at 5.20 a. m. a velocity of forty miles per hour. During the storm several houses in course of construction were blown down.

VI.—The afternoon reports of the 16th from northern Montana indicated the approach of a low area from the Northwest. In the evening reports of the 17th, Helena, Mont., reported a pressure of 29.66, with warm southerly winds in the vicinity. The area immediately started southward and reached the Texas coast on the afternoon of the 19th. Light pressure gradients and dry variable winds prevailed along its path during its progress southward. After leaving Texas the area moved eastward to the Georgia coast. Rain prevailed in the Mississippi Valley as far north as Iowa, and eastward to the Atlantic Ocean. The pressure and temperature gradients continued moderate, and only brisk winds were observed in the Gulf States. After leaving the Georgia coast the area moved directly northeast and at once began to develop decided cyclonic conditions, increased precipitation, and dangerous gales. The lowest isobar on the Georgia coast was 29.80. During the progress of the area northward the depression gradually increased until it arrived over the Gulf of Saint Lawrence on the afternoon of the 23d, when it was 28.90. Dangerous gales were reported from Cape Hatteras northward. The maximum velocity of wind (in miles per hour) was: Chincoteague, Va., 50; Sandy Hook, N. J., 52; Block Island, R. I., 48; and at Eastport, Me., 50. During the progress of this cyclone along the New Jersey and New England coasts the pressure gradient ranged between forty and sixty miles to the tenth of an inch pressure.

The following notes from observers relate to this low area:

Block Island, R. I.: on the 22d high easterly winds prevailed during the early morning, shifting to heavy northwest gale in the afternoon; maximum velocity forty-eight miles per hour.

Eastport, Me.: heavy snow began at 2.30 p. m. of the 22d; at 5.20 the precipitation changed to sleet, and at 7.54 to heavy rain. A gale set in at 3.10 p. m. and continued until 10.20 p. m., attaining at 6.45 p. m. a velocity of fifty miles per hour from the east. Rain fell throughout the night of the 22-23d, but changed to snow during the early morning of the 23d.

VII.—When number vi was in northern Texas on the morning of the 19th the major axis ran in a northerly and southerly direction, forming a trough extending to Manitoba. In southern Dakota, and within this trough, a secondary low area was noticed. Subsequent reports increased the gradient between it and the primary area, and it developed all the conditions necessary for a well-defined low area. It at once moved southeastward and joined number vi off the South Carolina coast on the afternoon of the 21st. Light rain or snow prevailed along its path.

VIII.—On the afternoon of the 22d a slight depression was central in western Manitoba. It moved southeastward into Minnesota and then changed its course to northeast and was located north of Lake Superior in the evening of the 23d. At this time another, and more marked, depression was in Dakota, moving southeastward. The following report failed to give sufficient data to locate number viii, and it is believed that it had ceased to be a distinct low area and had joined number ix. During its eastward progress light rains had prevailed in Dakota and Minnesota.

IX.—The morning map of the 23d showed that the pressure north of Montana had fallen to 29.47, with fresh and brisk southerly winds in the vicinity. A high area was located over Utah, with a maximum pressure of 30.36. This low area developed rapidly and moved southeast to Iowa in twenty-four hours, accompanied by brisk and high winds and light snow. The steepness of the gradient to the south and west had increased. Its rapid movement continued, and its course over the lower lakes, New England States, and the Maritime Provinces was made at the rate of forty-two miles per hour. The central depression increased as it approached the Gulf of Saint Lawrence, and on the morning of the 25th it was bounded by the isobar of 29.20. General rain or snow prevailed along its path and severe gales were reported from the Saint Lawrence Valley and the New England coast. The temperature fell rapidly behind this low area, some stations in the Lake region reporting a fall of 20° to 30° in twenty-four hours.

The following notes from observers are of interest in connection with this storm:

Des Moines, Iowa: the mercury fell rapidly in the early morning of the 24th, and during the remainder of the day it rose as rapidly. At 9 a. m. a northwesterly gale set in, attaining at 11 a. m. a velocity of thirty-eight miles per hour. The gale continued until 5 p. m.

Moorhead, Minn.: heavy northerly wind, with snow, began at 12.35 a. m. of the 24th. The gale continued until 10.05 a. m., attaining at 1.15 a. m. a velocity of forty miles per hour.

Vevay, Ind.: the voluntary observer at this place states that high winds prevailed on the 24th, blowing with increased velocity as the day advanced. At 7 a. m. it blew from the west; temperature 36°, rising to 70° at 3 p. m.; during the same time the pressure diminished 0.30.

Columbus, Ohio: on the 24th the pressure fell rapidly until 4.25 p. m., when it commenced to rise. At 4.30 p. m. a southwesterly gale set in and increased in velocity until 8.10 p. m., when it reached its maximum, fifty-one miles per hour. The gale continued until after midnight, and did considerable damage to roofs, fences, and light buildings. In the Hocking Valley, south of the city, a large number of houses were unroofed.

Sandusky, Ohio: a thunder-storm, with heavy rain and high wind, occurred on the afternoon of the 24th; maximum velocity of the wind, fifty miles per hour from the northwest.

Parkersburg, W. Va.: a gale commenced at 6 p. m. of the 24th and continued until 4 a. m. of the 25th. At Marietta considerable damage was done. At Ripley the court house was unroofed by the wind.

Helvetia, W. Va.: the heavy wind storm of the 24th did considerable damage to fencing and trees.

X.—This area of low pressure was first fully defined on the afternoon map of the 24th in Colorado, with lowest pressure at Denver, 29.75. As no reports had been received from the Southwest for several days it is not practicable to state whether or not it originated in Colorado. It at once moved slowly into northwestern Texas, the central pressure gradually decreasing. A high area appeared at this time in Manitoba, the centre bounded by an isobar of 30.50, with a minimum temperature of —19°. The gradients were sufficiently steep to cause strong "northers" in Nebraska and Kansas. The low area moved almost directly northeastward, and arrived off the coast of

Nova Scotia on the afternoon of the 29th, with a minimum pressure of 29.10. After reaching the Mississippi Valley general precipitation set in over the Mississippi and Missouri valleys and all the country to the eastward. Although the barometer gradient was at times quite steep, dangerous winds were only reported along the Atlantic coast north of Cape Hatteras. The temperature fell to the freezing point in all districts, except along the coast of the Gulf of Mexico, seriously injuring the early vegetable crops in the Southern States.

XI.—It was noticed on the afternoon map of the 28th that the temperature had risen 16°, and the pressure had decreased

.28 in twenty-four hours in northern Montana. The evening map of the same date permitted an isobar of 29.80 to be drawn, and other conditions appeared favorable to the presence of a moderate cyclone. The low area at once began to move in a southerly direction, arriving in northern Texas in twenty-four hours, with a central isobar of 29.50. A high area was then central in the Ohio Valley, with highest pressure 30.25. The low area changed its direction to an easterly course and passed off the coast of North Carolina on the evening of the 31st. Light rains prevailed over the Gulf States during its progress, with occasional thunder-storms.

NORTH ATLANTIC STORMS DURING MARCH, 1887.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to April 21, 1887.

Eleven depressions are traced, the tracks largely predominating to the southeastward and southward of Newfoundland and Nova Scotia, where their rate of progression was, in general, very slow, and the course of direction greatly diversified. During the first two decades of the month the more important storms which appeared were confined to the western half of the ocean, where deep barometric depressions, accompanied by storms of great violence, followed one another in rapid succession. During this period the barometric pressure over the eastern portion of the ocean remained almost continuously high, with generally settled weather within the region of observation east of the twenty-fifth meridian. During the last decade of the month cyclonic areas traversed the ocean from coast to coast, and the region of greatest storm frequency was included within an area extending from the east of the Banks of Newfoundland to the west coasts of the British Isles.

For March, 1886, ten depressions were traced, the tracks being rather evenly distributed over the ocean, with a general direction of movement from east to northeast. The depressions, as a rule, exhibited great depth and energy, and severe gales and generally unsettled weather prevailed throughout the month.

As compared with the corresponding month of previous years, the weather over the north Atlantic during March, 1887, was unusually severe west of the thirty-fifth meridian, this fact being due rather to the frequency of storms than to their exceptional individual strength.

The following are brief descriptions of the depressions:

1.—The presence of this storm to the southeast of Newfoundland was indicated by reports of the 1st, on which date it was central in about N. 45°, W. 48°, with barometric pressure about 29.50 (749.3). By the 2d the centre of depression had moved southeast to N. 41°, W. 43°, with a marked rise in central pressure, after which it apparently dissipated.

2.—This storm appeared on the 2d to the westward of the position occupied by depression number 1 on that date, having apparently developed to the southward of Newfoundland; passing slowly north of east, the storm-centre is traced to N. 42°, W. 46° by the 3d, and to N. 44°, W. 40° by the 4th, after which it disappeared. This depression, though shallow throughout its course, was accompanied on the 2d by severe storms, relative to which Capt. T. H. Fox, of the s. s. "Istrian," reports: "2d, in N. 41° 56', W. 51° 0' (at noon), wind veered to east and rapidly increased to a whole gale,

with thick fog and very heavy snow; found it necessary to put the ship's head to the sea and lessen speed; gale continued until noon of the 3d, in N. 41° 59', W. 48° 53'."

3.—This storm first appeared to the eastward of Newfoundland on the 6th, with central pressure about 29.10 (739.1); during the next four days the depression, shifting its position but slightly, occupied the ocean southeast of the Banks of Newfoundland, with barometric pressure ranging but slightly above 29.00 (736.6). During the 11th and 12th the centre of disturbance circled eastward, and apparently filled up to the northward of the Azores after the latter date. This depression was attended by disturbances of pronounced strength, as is shown by the following special reports:

Capt. A. G. Griffin, of the s. s. "Nederland," reports a whole gale from the 5th to the 7th; wind veered from s. to nw.; lowest barometer, 29.62 (752.3), at midnight of the 5th, in N. 43° 40', W. 41° 10'. Capt. T. M. Irwin, of the s. s. "Lepanto," reports a whole northerly gale on the 5th and 6th; lowest barometer, 29.52 (749.8), at 4 p. m. of the 5th, in N. 42° 20', W. 47° 40'. Capt. W. R. Lord, of the s. s. "Critic," reports an easterly hurricane on the 6th; lowest barometer, 29.23 (742.4), at noon, in N. 47° 5', W. 43° 41'. Capt. H. Parsell, of the s. s. "Adriatic," reports a strong to whole gale on the 7th and 8th; wind backed from se. to ne. and n.; lowest barometer, 29.00 (736.6), at 5 p. m. of the 7th, in N. 45° 47', W. 43° 7'. During the gale the sea was very confused, being characterized chiefly by a long heavy swell from n. and nnw., meeting a heavy sea from sse., continuing, after the backing of the wind, until midnight, then subsiding quickly. The north swell had no apparent local cause, and it appeared as though the locality steered over had been recently disturbed. Capt. G. Bakker, of the s. s. "W. A. Scholten," reports a storm of hurricane force from n. to nnw.; lowest barometer, 29.34 (745.2), at 12 noon of the 7th, in N. 42° 12', W. 46° 42'. Oil was used with good effect to keep the heavy waves clear of the ship. Capt. A. Redford, of the s. s. "City of Richmond," reports a whole n. to nnw. gale on the 7th and 8th; lowest barometer, 29.32 (744.7), at 2 a. m. of the 7th, in N. 40° 0', W. 51° 50'. The s. s. "Critic," having passed through the centre of a cyclone, encountered a very high sea, and laid to thirty-six hours, in N. 48° 49', W. 40° 9'. The s. s. "Bedford," Capt. T. Aitkenhead, commanding, in N. 39° 50', W. 43° 24' (at noon), had a fierce w. by n. gale, with terrific squalls; at 6 p. m. the wind shifted to n. in a heavy gale, with squalls of hurricane force and dangerous seas, which condition continued until midnight without abatement.

Capt. W. C. Bacon, of the s. s. "Coventry," reports: "8th, in N. 32° 27', W. 26° 11' (at noon); heavy squalls from the westward and much rain; barometer fell to 29.45 (748.0), and afterwards rose to 29.55 (750.6), but fell again to 29.25 (742.9) in the evening, with the wind backing to sw. and blowing force 8, with occasional showers." Capt. G. W. Murray, of the s. s. "Sapphire," reports: "9th, in N. 32° 58', W. 44° 28' (at noon); 6 hours, tremendous squalls of wind and rain, wsw. gale, incessant, barometer falling rapidly; 13 hours, wind hauled to nw., with rising barometer and terrific breaking seas